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In re Application of

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RANDY HOFFMAN, HAI CHIANG
and JOHN WAGNER

HP Docket No. 200311332-2

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Examiner J. Mondt

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Group Art Unit 3663

For : SEMICONDUCTOR DEVICE

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Commissioner for Patents
P. O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

AMENDED BRIEF OF APPELLANTS

This Amended Brief is presented in opposition to the Examiner's rejection of claims 4, 6-9, 11, 12, 14, 15, 19, 21-24, 26, 29, 31-39, 48 and 50-67 in the Office action dated November 30, 2006. Pursuant to the Notification of Non-Compliant Appeal Brief dated July 18, 2007, this Amended Brief is intended to replace the Brief of Appellants filed March 27, 2007.

I. REAL PARTY IN INTEREST

The real party in interest is Hewlett-Packard Development Company, LP, a limited partnership established under the laws of the State of Texas and having a principal place of business at 20555 S.H. 249 Houston, TX 77070, U.S.A. (hereinafter "HPDC"). HPDC is a Texas limited partnership and is a wholly-owned affiliate of

Hewlett-Packard Company, a Delaware Corporation, headquartered in Palo Alto, CA.
The general or managing partner of HPDC is HPQ Holdings, LLC.

II. RELATED APPEALS AND INTERFERENCES

There are no known related appeals or interferences.

III. STATUS OF CLAIMS

The present application was filed on January 23, 2004 with original claims 1-49. In the response to restriction requirement dated July 27, 2005, Appellants elected the invention of claims 1-43 and 45-49, without traverse. In the response dated January 5, 2006, Appellants canceled claim 44 and amended claims 11, 12, 23, 36, and 37. In the response dated May 17, 2006, responding to an indication of allowable subject matter, Appellants canceled claims 1-3, 5, 10, 13, 16-18, 20, 25, 27, 28, 30, 40-43, 45-47, and 49; and amended claims 4, 6-9, 11, 12, 14, 19, 21-24, 26, 29, 31-38, and 48. In the response dated September 7, 2006, Appellants amended claims 6-9, 11, 12, 14, 21-24, 26, 29, and 31-38; and added new claims 50-67.

Claims 4, 6-9, 11-12, 14, 15, 19, 21-24, 26, 29, 31-39, 48, and 50-67 as amended in the response dated September 7, 2006 are the claims at issue in this appeal.

IV. STATUS OF AMENDMENTS

No amendments have been made subsequent to the Office action dated November 30, 2006.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The summary is set forth in exemplary embodiments. Discussions of selected elements and recitations of claimed subject matter can be found at least at the cited locations in the specifications and drawings. The claims of the present application are directed to semiconductor devices, thin-film transistors, and displays as generally described at page 2, line 8 to page 7, line 14 of the specification, and as set out in Figures 1-8.

More particularly, independent Claim 4 is directed to a semiconductor device that includes a source electrode (20), a drain electrode (22), a channel (18) coupled to the source electrode and the drain electrode, and a gate electrode (12), as depicted in Fig. 1, and as described in the specification at page 2, line 14 to page 3, line 5. Specifically, at least a portion of the channel (18) of the semiconductor device (10) is formed from a zinc-tin oxide compound having the stoichiometry Zn_2SnO_4 , as described in the specification at page 3, line 19 to page 4, line 15.

Independent Claim 19 is directed to a three-port semiconductor device that includes a source electrode (20), a drain electrode (22), a gate electrode (12), and a means for providing a channel (18) disposed between the source electrode and the drain electrode, as depicted in Fig. 1, and as described in the specification at page 2, line 14 to page 3, line 5. The means for providing a channel is configured to permit movement of electric charge through the channel between the source electrode and the gate electrode in response to a voltage applied at the gate electrode, and the channel is formed at least in part from a semiconductor having the stoichiometry: Zn_2SnO_4 , as described in the specification at page 3, line 19 to page 4, line 15.

Independent claim 48 is directed to a display (40), where the display includes a plurality of display elements (42) that are configured to operate collectively to display images, as described in the specification at page 4, line 16 to page 5, line 5. Each of the display elements (42) includes a semiconductor device configured to control light emitted by the display element. The semiconductor device includes a source electrode (20), a drain electrode (22), a channel (18) coupled to the source electrode and the drain electrode, and a gate electrode (12) configured to permit application of an electric field to the channel, as depicted in Fig. 1, and as described in the specification at page 2, line 14 to page 3, line 5. The coupled channel (18) includes a ternary compound containing zinc, tin and oxygen, and where at least a portion of the channel of the semiconductor device is formed from a zinc-tin oxide compound that has the stoichiometry Zn_2SnO_4 , as discussed in the specification at page 3, line 19 to page 4, line 15, and as shown in Figs. 1 and 4.

Independent Claim 50 is directed to a semiconductor device that includes a source electrode (20), a drain electrode (22), a channel (18) coupled to the source electrode and the drain electrode, and a gate electrode (12) configured to permit application of an electric field to the channel, as depicted in Fig. 1, and as described in the specification at page 2, line 14 to page 3, line 5. Specifically, the channel (18) of the semiconductor device (10) includes a ternary compound containing zinc, tin and oxygen, as described in the specification at page 3, line 19 to page 4, line 15.

Independent Claim 56 is directed to a three-port semiconductor device that includes a source electrode (20), a drain electrode (22), a gate electrode (12), and a

means for providing a channel (18) disposed between the source electrode and the drain electrode, as depicted in Fig. 1, and as described in the specification at page 2, line 14 to page 3, line 5. The means for providing a channel is configured to permit movement of electric charge through the channel between the source electrode and the gate electrode in response to a voltage applied at the gate electrode, and the means for providing a channel is formed at least in part from a ternary compound containing zinc, tin and oxygen, as described in the specification at page 3, line 19 to page 4, line 15.

Independent Claim 60 is directed to a thin-film transistor that includes a gate electrode (12), a channel layer (18) formed from a zinc-tin oxide material, a dielectric material disposed between and separating the gate electrode (12) and the channel layer (18), and first and second electrodes spaced from each other and disposed adjacent the channel layer on a side of the channel layer opposite the dielectric material, such that the channel layer is disposed between and electrically separates the first and second electrodes, as described in the specification at page 5, line 18 to page 7, line 4, and in Figs. 5-8.

Independent claim 64 is directed to a display (40), where the display includes a plurality of display elements (42) that are configured to operate collectively to display images, as described in the specification at page 4, line 16 to page 5, line 5. Each of the display elements (42) includes a semiconductor device configured to control light emitted by the display element. The semiconductor device includes a source electrode (20), a drain electrode (22), a channel (18) coupled to the source electrode and the drain electrode, and a gate electrode (12) configured to permit application of an electric

field to the channel, as depicted in Fig. 1, and as described in the specification at page 2, line 14 to page 3, line 5. The coupled channel (18) includes a ternary compound containing zinc, tin and oxygen as discussed in the specification at page 3, line 19 to page 4, line 15, and as shown in Figs. 1 and 4.

VI. GROUND OF REJECTION

In the Office action dated November 30, 2006, claims 4, 6-9, 11-12, 14-15, 19, 21-24, 26, 29, 31-39, 48, and 50-67 were rejected. More specifically,

- Claims 4, 6-9, 11, 26, 29, 31-36, 48, and 50-63 were rejected under 35 U.S.C. § 102(e) as being anticipated over Carcia et al. (U.S. Patent Publication No. 2004/0127038);
- Claims 19, 21, 22, and 24 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Carcia et al. (U.S. Patent Publication No. 2004/0127038) in view of Taylor (U.S. Patent No. 4,521,698);
- Claims 12 and 37 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Carcia et al. as applied to claim 50 and 56, respectively, in view of Hong et al. (U.S. Patent no. 6,674,495);
- Claim 23 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Carcia et al. and Taylor as applied to claim 19 above, and further in view of Hong et al.

- Claims 14 and 38 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Carcia et al. as applied to claims 55 and 60 in view of Krivokapic et al. (U.S. Patent No. 6,100,558).
- Claims 15 and 39 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Carcia et al. in view of Krivokapic et al., as applied to claims 14 and 38, and further in view of Hornik et al; and
- Claims 64-67 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Carcia et al. in view of Ando et al. (U.S. Patent no. 6,184,946).

VII. ARGUMENT

Rejections under 35 U.S.C. § 102

1. Claims 4, 6-9, 11, 26, 29, 31-36, 48, and 50-63 are rejected under 35 U.S.C. § 102(e) as being anticipated over Carcia et al. (U.S. Patent Publication No. 2004/0127038).

Appellant asserts that the Examiner has applied an improper standard for determining the anticipation of the claimed subject matter, and that the Carcia et al. reference fails to anticipate claims 4, 6-9, 11, 26, 29, 31-36, 48, and 50-63.

In order to anticipate a claim under 35 U.S.C. § 102(e), a reference must teach each and every element as set forth in the claim that is, the identical invention must be shown in as complete detail as is contained in the patent claim. *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 U.S.P.Q.2d 1913, 1920 (CAFC 1989).

The Examiner suggests that the Carcia et al. reference discloses a semiconductor device that includes a source electrode, a drain electrode, a channel

coupled to the source and drain electrode, and a gate electrode. The Examiner further suggests that the channel of the device of Carcia et al. is comprised of a ternary compound containing zinc, tin and oxygen. Furthermore, the Examiner suggests that at least a portion of the channel is formed from a zinc-tin oxide compound having the stoichiometric formula Zn_2SnO_4 . Appellants respectfully disagree.

Carcia et al. discloses semiconductor thin film transistors having a transparent oxide semiconductor "selected from the group consisting of zinc oxide (ZnO), indium oxide (In_2O_3), tin oxide (SnO_2), or cadmium oxide (CdO) semiconductor and combinations thereof" (para. 0010, lines 4-7). The Examiner is relying upon the reference by Carcia et al. to "combinations thereof" as sufficient disclosure to anticipate every possible combination or subcombination of the listed oxides, including the ternary zinc, tin, and oxygen composition recited in independent claims 56 and 60, and the compositions having a stoichiometry of Zn_2SnO_4 recited in independent claims 4 and 48. Appellants respectfully disagree, and suggest that this is an improper standard for determining anticipation under 35 U.S.C. § 102.

A compound is anticipated only if its disclosure in a single reference places that composition in possession of the public. The reference must "clearly and unequivocally disclose the claimed compound or direct those skilled in the art to the compound without any need for picking, choosing, and combining various disclosures...". *In re Arkley*, 455 F.2d 586, 587, 172 U.S.P.Q. 524, 526 (C.C.P.A. 1972), emphasis added. Appellants note that Carcia et al. fails to "clearly and unequivocally" disclose thin film transistors

having a channel that incorporates a zinc-tin oxide, much less the specific oxide Zn_2SnO_4 .

At most, Carcia et al. may disclose a genus of semiconductor compositions. But It has been well-established that the disclosure of a genus in the prior art is not necessarily a disclosure of every species that is a member of that genus. *In re Baird*, 16 F.3d 380, 29 U.S.P.Q.2d 1550 (C.A.F.C. 1994). In fact, a genus can only anticipate a species within that genus if one of ordinary skill "would immediately envisage" the claimed compound from the disclosed genus. *In re Petering*, 301 F.2d 676,682, 133 U.S.P.Q. 275, 280 (C.C.P.A. 1962). The effect of a disclosure of a genus on the patentability of a species within the genus is highly fact-dependent. Patentability depends upon the size of the genus, but also upon the details of the disclosure itself, with particular attention being given to any teachings of the reference with respect to the selection of preferred sub-genera and/or species.

In the case of Carcia et al., the references discloses a transparent oxide semiconductor that is selected from ZnO , In_2O_3 , SnO_3 , or CdO , or combinations thereof. The genus therefore includes four types of binary oxides (having one metal and oxygen), six types of ternary oxides (having two metals), four types of quaternary oxides (having three metals), and one oxide family that includes all four metals and oxygen.

A ternary composition containing zinc, tin, and oxygen, as recited in claims 50, 56, 60, and 64, therefore corresponds to selection of one specific oxide family out of 15 possible families. When the additional variation in oxide stoichiometries is also considered, the number of possible formulations increases substantially. However, the

specific formula Zn_2SnO_4 , as recited in claims 4, 19, and 48, corresponds to a single specific composition selected from the entirety of the range of possible compositions permitted by Carcia et al.

Furthermore, the guidance provided by Carcia et al. must also be considered. In particular, although a very broad genus of semiconductor compositions is disclosed, Carcia et al. only specifically exemplifies the compositions ZnO and In_2O_3 . The Carcia et al. patent refers extensively to a ZnO thin film transistor, for example in Figures 3-11 and Examples 1-7, and also exemplifies an indium oxide thin film semiconductor in Figures 12 and 13 and in Examples 8 and 9. Carcia et al. fails to exemplify any other metal oxide composition.

More specifically, Carcia et al. fails to exemplify any ternary oxide compositions, and furthermore fails to specifically exemplify any transistors that incorporate semiconductor composition that includes tin. Given the whole of the disclosure of Carcia et al., a skilled artisan would certainly not be led to "immediately envisage" the claimed compositions, as is required in order to meet the standard for anticipation of a species by disclosure of a genus.

In the absence of a disclosure of each and every element of the rejected claims, as recited in the claims, Appellants suggest that the Carcia et al. reference fails to anticipate the subject matter of independent claims 4, 48, 50, 56, and 60. As claims 6-9, 11, 26, 31-36, 51-55, 57-59, and 61-63 depend directly or indirectly from claims 4, 48, 50, 56, and 60, Appellants suggest they are similarly not anticipated by the Carcia et al. reference.

In view of the above remarks, Appellants respectfully request the withdrawal of the rejection of claims 4, 6-9, 11, 26, 29, 31-36, 48, and 50-63 under 35 U.S.C. § 102(e).

Rejections under 35 U.S.C. § 103

2. Claims 19, 21, 22, and 24 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Carcia et al., in view of Taylor (U.S. Patent no. 4,521,698).

Appellant asserts that the Examiner has applied an improper standard for determining the obviousness of the claimed subject matter, and that even in combination, the Carcia et al. and Taylor references fail to establish the *prima facie* obviousness of the claimed subject matter.

In order to establish the *prima facie* obviousness, the Examiner must satisfy three criteria. There must be some suggestion or motivation present in the prior art to modify the reference or to combine the reference teachings. The prior art must also provide a reasonable expectation of success. Additionally, the prior art references must teach or suggest each and every element of the claim.

The fact that a claimed species may be encompassed by a disclosed genus does not by itself render that species obvious. *In re Baird*, 16 F.3d 380, 29 U.S.P.Q.2d 1550 (C.A.F.C. 1994). In the present case, and as discussed above, the Carcia et al. reference fails to disclose the particular semiconductor compositions recited in the rejected claims. Appellants suggest that the Taylor reference similarly fails to disclose or suggest either a semiconductor including a ternary compound containing zinc, tin and oxygen, as recited in claim 56 and therefore in dependent claims 21, 22, and 24, or the specific formulation Zn_2SnO_4 , as recited in claim 19.

However, even if the Carcia et al. and Taylor references were to succeed in establishing a *prima facie* case of obviousness, the *prima facie* case can be rebutted if the prior art in any material respect taught away from the claimed invention. *In re Geisler*, 116 F.3d 1465, 43 U.S.P.Q.2d 1362 (C.A.F.C. 1997). As discussed above, the Carcia et al. reference failed to disclose any specific examples of semiconductors having ternary compositions, and failed to disclose any specific examples of semiconductors including tin oxides. On the Contrary, Carcia et al. specifically disclosed, and therefore suggested the preparation of, semiconductors prepared from zinc oxide and indium oxide compositions. Appellants suggest that the Carcia et al. reference therefore effectively teaches away from the zinc-tin-oxide compositions recited in the instant claims. The Examiner has failed to identify any particular suggestion that would motivate an artisan of ordinary skill to select the particular compositions recited in the rejected claims when preparing the claimed semiconductor devices.

For at least the reasons provided above, Appellants respectfully suggest that the Examiner has failed to establish the *prima facie* obviousness of claims 19, 21, 22, and 24, or in the alternative have successfully rebutted the *prima facie* obviousness of claims 19, 21, 22, and 24.

3. The Examiner has rejected claims 12 and 37 under 35 U.S.C. § 103(a) as being unpatentable over Carcia et al. as applied to claim 50 and 56, respectively, in view of Hong et al. (U.S. Patent no. 6,674,495).

The Examiner suggests that Carcia anticipates claims 50 and 56, and that as the Hong et al. reference teaches that the source and drain electrodes may be indium-tin oxide electrodes, an artisan of ordinary skill would be motivated by the cited references to prepare the devices of claims 12 and 37. Appellants respectfully disagree.

Appellants disagree that Carcia et al. anticipates the subject matter of claims 50 and 56, for at least the reasons provided above. The Hong et al. reference similarly fails to disclose or suggest a semiconductor having a channel that is formed at least in part from a ternary compound containing zinc, tin and oxygen.

As discussed above, the Carcia et al. reference teaches away from the claimed formulation, exemplifying only semiconductors prepared with zinc-oxide and indium-oxide formulations. Similarly, Hong et al. fails to teach a semiconductor channel between a source electrode and drain electrode that includes a ternary zinc, tin, and oxygen compound. In fact, Hong et al. teaches that the transistor semiconductor "made of semiconductor such as hydrogenated amorphous silicon" (see for example col. 8, lines 62-64; col. 13, lines 36-41; col. 20, lines 16-18).

Both Carcia et al. and Hong et al. teach semiconductor formulations that are distinct from the recited zinc, tin, and oxygen compounds. Appellants respectfully suggest that Carcia et al. and Hong et al. fail to establish the *prima facie* obviousness of claims 50 and 56, or in the alternative, Carcia et al. and Hong et al. teach away from the

semiconductor devices of claims 50 and 56, respectively, and thereby effectively rebut the *prima facie* obviousness of those claims.

4. The Examiner has rejected claim 23 under 35 U.S.C. § 103(a) as being unpatentable over Carcia et al. and Taylor as applied to claim 19 above, and further in view of Hong et al.

Claim 23 depends from independent claim 56. Appellants disagree that Carcia et al. anticipates the subject matter of claim 56, for at least the reasons provided above for claim 19. Specifically, Appellants suggest that neither the Carcia et al. reference or Taylor reference disclose the particular semiconductor compositions recited in the rejected claims. Furthermore, the Hong et al. reference fails to disclose or suggest a semiconductor having a channel that is formed at least in part from a ternary compound containing zinc, tin and oxygen.

Even if the references, singly or in combination, were to establish the *prima facie* obviousness of claim 23, Appellants suggest that both Carcia et al. and Hong et al. teach away from the claimed formulations, as Carcia et al. exemplify only zinc-oxide and indium-oxide formulations, while Hong et al. teaches a transistor "made of semiconductor such as hydrogenated amorphous silicon".

5. The Examiner has rejected claims 14 and 38 under 35 U.S.C. § 103(a) as being unpatentable over Carcia et al. in view of Krivokapic et al. (U.S. Patent no. 6,100,558).

In particular, the Examiner suggests that Carcia et al. anticipates claims 55 and 60, and that it would be obvious to utilize a dielectric that is an aluminum-titanium oxide, as taught by Krivokapic et al. in the device of Carcia et al.

Appellants note that Claim 14 depends from independent claim 55, and claim 38 depends from independent claim 60. Appellants disagree that Carcia et al. anticipates the subject matter of claims 55 and 60, for at least the reasons provided above with respect to those claims. Specifically, Appellants suggest that the Carcia et al. reference fails to disclose the particular semiconductor compositions recited in the rejected claims.

The Krivokapic et al. reference similarly fails to disclose or suggest a semiconductor including a ternary compound containing zinc, tin and oxygen, or a thin-film transistor including a channel layer formed from a zinc-tin oxide material.

Appellants further suggest that even if the cited references were to establish the *prima facie* obviousness of claims 14 and 38, Carcia et al. teach away from the claimed formulations, as discussed above, thereby rebutting the *prima facie* case.

6. The Examiner has rejected claims 15 and 39 under 35 U.S.C. § 103(a) as being unpatentable over Carcia et al. in view of Krivokapic et al., as applied to claims 14 and 38, and further in view of Hornik et al.

In particular, the Examiner suggests that claims 14 and 38 are unpatentable over Carcia et al. in view of Krivokapic et al., and that it would have been obvious in view of Hornik et al. to include the elements of claims 15 and 39, respectively, in the device of Carcia et al.

Claims 14 and 39 depend from claims 50 and 60, respectively. As discussed above, the Carcia et al. reference fails to disclose the particular semiconductor compositions recited in claims 50 and 60. Appellants suggest that the Taylor reference also fails to disclose or suggest either a semiconductor device including a ternary

compound containing zinc, tin and oxygen, as recited in claim 50 and therefore in dependent claim 14, or a thin-film transistor including a channel layer formed from a zinc-tin oxide material, as recited in claim 60, and therefore in dependent claim 39.

Also as discussed above, even if the Carcia et al. and Taylor references succeed in establishing a *prima facie* case of obviousness, Appellants suggest that the *prima facie* case is rebutted, as the Carcia et al. reference teaches away from the zinc-tin oxide compositions recited in the rejected claims.

7. The Examiner has rejected claims 64-67 under 35 U.S.C. § 103(a) as being unpatentable over Carcia et al. in view of Ando et al. (U.S. Patent no. 6,184,946).

The Examiner suggests that Carcia et al. discloses a semiconductor device having a channel that includes a ternary compound containing zinc, tin and oxygen, in particular a composition having the stoichiometry $Zn_xSn_yO_z$, where x, y, and z are positive numbers, a composition having the formula $ZnSnO_3$, and a composition having the formula $(ZnO)_i(SnO_2)_{1-j}$.

Appellants disagree. As discussed above, the mere disclosure of a genus does not constitute the specific disclosure of each and every species encompassed by the genus. In this case, the Carcia et al. reference fails to exemplify any particular semiconductor compositions other than ZnO and In_2O_3 , and therefore fails to provide a suggestion to use the zinc-tin oxide compositions recited in claims 64-67. Appellants suggest that Ando et al. similarly fails to disclose the particular zinc-tin oxide compositions recited in claims 64-67.

Furthermore, Carcia et al. and Ando et al. teach away from the zinc-tin oxide compositions recited in the rejected claims, as Carcia et al. teaches the selection of semiconductors ZnO and In₂O₃, while Ando et al. discloses semiconductors prepared from amorphous silicon.

As set out at MPEP § 2143.01, the prior art must suggest the desirability of the invention, that is, the motivation to formulate the invention cannot be found in applicant's specification, which is then used as a filter through which to view the prior art. The mere fact that references *can be* combined or modified does not render the resultant combination obvious unless the prior art *also* suggests the desirability of the combination. The mere fact that the prior art *may* be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art also suggests the desirability of the modification.

In the absence of a disclosure of each and every element of the rejected claims, the absence of specific motivation or suggestion in the cited references to combine or modify the reference teachings as suggested by the Examiner, and in view of the teaching of the cited references, Appellant suggests that claims 5, 9, 12, 21-24, 37, 39, and 64-67 are not obvious under 35 U.S.C. § 103, and respectfully request the withdrawal of the rejection of those claims.

VIII. CLAIMS APPENDIX

1. (Cancelled)

2. (Cancelled)

3. (Cancelled)

4. (Previously Presented) A semiconductor device, comprising:

a source electrode;

a drain electrode;

a channel coupled to the source electrode and the drain electrode and comprised of a ternary compound containing zinc, tin and oxygen, where at least a portion of the channel is formed from a zinc-tin oxide compound having the following stoichiometry: Zn_2SnO_4 ; and

a gate electrode configured to permit application of an electric field to the channel.

5. (Cancelled)

6. (Previously Presented) The semiconductor device of claim 50, where the zinc-tin oxide compound is substantially amorphous.

7. (Previously Presented) The semiconductor device of claim 50, where one or more of the source, drain, and gate electrodes is fabricated so as to be at least partially transparent.

8. (Previously Presented) The semiconductor device of claim 50, where the channel further includes phase-segregated ZnO .

9. (Previously Presented) The semiconductor device of claim 50, where the channel further includes phase-segregated SnO_2 .

10. (Cancelled)
11. (Previously Presented) The semiconductor device of claim 50, where the channel is adapted to be deposited using an RF sputtering process.
12. (Previously Presented) The semiconductor device of claim 50, where the source electrode and the drain electrode are formed from an indium-tin oxide material, and are patterned so that the source electrode and drain electrode are physically separate from one another.
13. (Cancelled)
14. (Previously Presented) The semiconductor device of claim 55, where the dielectric material is an aluminum-titanium oxide material.
15. (Original) The semiconductor device of claim 14, where the dielectric material includes:
 - a first outer layer immediately adjacent to and in contact with the channel layer;
 - a second outer layer immediately adjacent to and in contact with the gate electrode, where the first and second outer layers are each formed from Al_2O_3 ; and
 - alternating interior layers of AlO_x and TiO_y between the first and second outer layers, where x and y are positive nonzero values.
16. (Cancelled)
17. (Cancelled)
18. (Cancelled)

19. (Previously Presented) A three-port semiconductor device, comprising:

a source electrode;

a drain electrode;

a gate electrode; and

means for providing a channel disposed between the source electrode and drain electrode, the means for providing a channel configured to permit movement of electric charge therethrough between the source electrode and the gate electrode in response to a voltage applied at the gate electrode, the means for providing a channel formed at least in part from a ternary compound containing zinc, tin and oxygen, where the means for providing a channel includes means for providing a semiconductor formed from a zinc-tin oxide compound having the following stoichiometry: Zn_2SnO_4 .

20. (Cancelled)

21. (Previously Presented) The semiconductor device of claim 57, where the means for providing a semiconductor is substantially amorphous.

22. (Previously Presented) The semiconductor device of claim 57, where one or more of the source, drain, and gate electrodes is fabricated so as to be at least partially transparent.

23. (Previously Presented) The semiconductor device of claim 56, where the source electrode and the drain electrode are formed from an indium-tin oxide material, and are patterned so that the source electrode and the drain electrode are physically separate from one another.

24. (Previously Presented) The semiconductor device of claim 56, further comprising means for providing a dielectric disposed between and physically separating the gate electrode from the means for providing a channel.

25. (Cancelled)

26. (Previously Presented) The thin-film transistor of claim 60, where the thin-film transistor is configured so that the ability of the channel layer to convey electric charge between the first and second electrodes in response to a potential difference applied across the first and second electrodes is dependent upon a gate voltage applied at the gate electrode.

27. (Cancelled)

28. (Cancelled)

29. (Previously Presented) The thin-film transistor of claim 61, where at least a portion of the channel layer is formed from a zinc-tin oxide compound having the following stoichiometry: Zn_2SnO_4 .

30. (Cancelled)

31. (Previously Presented) The thin-film transistor of claim 61, where the zinc-tin oxide compound is substantially amorphous.

32. (Previously Presented) The thin-film transistor of claim 61, where one or more of the source, drain, and gate electrodes is fabricated so as to be at least partially transparent.

33. (Previously Presented) The thin-film transistor of claim 61, where the channel layer further includes phase-segregated ZnO.

34. (Previously Presented) The thin-film transistor of claim 61, where the channel layer further includes phase-segregated SnO_2 .

35. (Previously Presented) The thin-film transistor of claim 60, where one or more of the source, drain, and gate electrodes is fabricated so as to be at least partially transparent.

36. (Previously Presented) The thin-film transistor of claim 60, where the channel layer is adapted to be deposited using an RF sputtering process.

37. (Previously Presented) The thin-film transistor of claim 60, where the first and second electrodes are formed from an indium-tin oxide material, and are patterned so that the first and second electrodes are physically separate from one another.

38. (Previously Presented) The thin-film transistor of claim 60, where the dielectric material is an aluminum-titanium oxide material.

39. (Original) The thin-film transistor of claim 38, where the dielectric material includes:

a first outer layer immediately adjacent to and in contact with the channel layer;

a second outer layer immediately adjacent to and in contact with the gate electrode, where the first and second outer layers are each formed from Al_2O_3 ; and

alternating interior layers of AlO_x and TiO_y between the first and second outer layers, where x and y are positive nonzero values.

40. (Cancelled)

41. (Cancelled)

42. (Cancelled)

43. (Cancelled)

44. (Cancelled)

45. (Cancelled)

46. (Cancelled)

47. (Cancelled)

48. (Previously Presented) A display, comprising:

a plurality of display elements configured to operate collectively to display images, where each of the display elements includes a semiconductor device configured to control light emitted by the display element, the semiconductor device including:

a source electrode;

a drain electrode;

a channel coupled to the source electrode and the drain electrode and comprised of a ternary compound containing zinc, tin and oxygen, where at least a portion of the channel of the semiconductor device is formed from a zinc-tin oxide compound has the following stoichiometry: Zn_2SnO_4 ; and

a gate electrode configured to permit application of an electric field to the channel.

49. (Cancelled)

50. (Previously Presented) A semiconductor device, comprising:
- a source electrode;
 - a drain electrode;
 - a channel coupled to the source electrode and the drain electrode and comprised of a ternary compound containing zinc, tin and oxygen; and
 - a gate electrode configured to permit application of an electric field to the channel.
51. (Previously Presented) The semiconductor device of claim 50, where at least a portion of the channel is formed from a zinc-tin oxide compound having the following stoichiometry: $Zn_xSn_yO_z$, where x, y and z have positive non-zero values.
52. (Previously Presented) The semiconductor device of claim 51, where the zinc-tin oxide compound has the following stoichiometry: $ZnSnO_3$.
53. (Previously Presented) The semiconductor device of claim 51, where the zinc-tin oxide compound has the following stoichiometry: $(ZnO)_j(SnO_2)_{1-j}$, where j is between 0.05 and 0.95.
54. (Previously Presented) The semiconductor device of claim 50, where one or more of the source, drain, and gate electrodes is fabricated so as to be at least partially transparent.
55. (Previously Presented) The semiconductor device of claim 50, where the gate electrode is physically separated from the channel by a dielectric material.

56. (Previously Presented) A three-port semiconductor device, comprising:

a source electrode;

a drain electrode;

a gate electrode; and

means for providing a channel disposed between the source electrode and drain electrode, the means for providing a channel configured to permit movement of electric charge therethrough between the source electrode and the gate electrode in response to a voltage applied at the gate electrode, the means for providing a channel formed at least in part from a ternary compound containing zinc, tin and oxygen.

57. (Previously Presented) The semiconductor device of claim 56, where the means for providing a channel includes means for providing a semiconductor formed from a zinc-tin oxide compound having the following stoichiometry: $Zn_xSn_yO_z$, where x, y and z have positive non-zero values.

58. (Previously Presented) The semiconductor device of claim 57, where the zinc-tin oxide compound has the following stoichiometry: $ZnSnO_3$.

59. (Previously Presented) The semiconductor device of claim 57, where the means for providing a semiconductor includes a compound that has the following stoichiometry: $(ZnO)_j(SnO_2)_{1-j}$, where j is between 0.05 and 0.95.

60. (Previously Presented) A thin-film transistor, comprising:
a gate electrode;
a channel layer formed from a zinc-tin oxide material;
a dielectric material disposed between and separating the gate electrode and the channel layer; and

first and second electrodes spaced from each other and disposed adjacent the channel layer on a side of the channel layer opposite the dielectric material, such that the channel layer is disposed between and electrically separates the first and second electrodes.

61. (Previously Presented) The thin-film transistor of claim 60, where at least a portion of the channel layer is formed from a zinc-tin oxide compound having the following stoichiometry: $Zn_xSn_yO_z$, where x, y and z have positive non-zero values.

62. (Previously Presented) The thin-film transistor of claim 61, where the zinc-tin oxide compound has the following stoichiometry: $ZnSnO_3$.

63. (Previously Presented) The thin-film transistor of claim 61, where the zinc-tin oxide compound has the following stoichiometry: $(ZnO)_j(SnO_2)_{1-j}$, where j is between 0.05 and 0.95.

64. (Previously Presented) A display, comprising:

a plurality of display elements configured to operate collectively to display images, where each of the display elements includes a semiconductor device configured to control light emitted by the display element, the semiconductor device including:

a source electrode;

a drain electrode;

a channel coupled to the source electrode and the drain electrode and comprised of a ternary compound containing zinc, tin and oxygen; and

a gate electrode configured to permit application of an electric field to the channel.

65. (Previously Presented) The display of claim 64, where at least a portion of the channel of the semiconductor device is formed from a zinc-tin oxide compound having the following stoichiometry: $Zn_xSn_yO_z$, where x, y and z have positive non-zero values.

66. (Previously Presented) The display of claim 65, where the zinc-tin oxide compound has the following stoichiometry: $ZnSnO_3$.

67. (Previously Presented) The display of claim 65, where the zinc-tin oxide compound has the following stoichiometry: $(ZnO)_j(SnO_2)_{1-j}$, where j is between 0.05 and 0.95.

IX. EVIDENCE APPENDIX

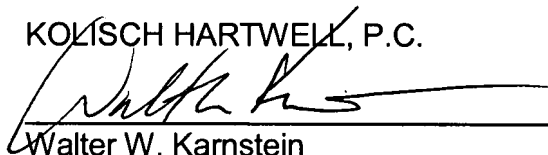
None.

X. RELATED PROCEEDINGS APPENDIX

None.

Respectfully submitted,

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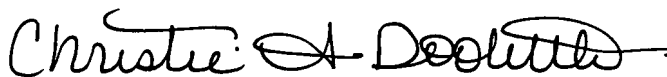
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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Mail Stop Appeal Brief-Patents, Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450 on August 16, 2007.



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